The Mean Right Ascensions and Proper Motions of 254 Stars

A Thesis Presented to the Faculty of Philosophy of the University of Pennsylvania

BY

H. B. EVANS

In Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

Philadelphia.

The Mean Right Ascensions and Proper Motions of 254 Stars

A Thesis Presented to the Faculty of Philosophy of the University of Pennsylvania

ACAD
LIBRARY
BIBL

BY

H. B. EVANS

In Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

Mean Right Ascensions and Proper Motions of 254 Stars.

Introduction.

The object of the present discussion is primarily the derivation from all available data of definitive values of the Right Ascensions and Proper Motions of 254 stars. These stars constitute the star list used by Professor C. L. Doolittle in the investigation of the variation of latitude at the Sayre Observatory of Lehigh University in the years 1876 to 1893 inclusive. For use in the final discussion of these observations the Declinations have been investigated by Professor Doolittle. It is hoped that the results of the latter discussion may prove valuable in lines of investigation other than that for which it has been executed. With this end in view, the Right Ascensions have here been reduced according to the same method, and it is hoped with the same care and thoroughness, as in the case of the Declinations. For the sake of completeness, and with the permission of Professor Doolittle, the Declination data and results are given with those of the Right Ascensions.

Authorities.

In the list of catalogues employed it is not thought necessary to give more than the names of those which are generally well known. The works themselves should be found in every astronomical library. In case they are not readily accessible, further information regarding them may be obtained from Newcomb's *New Catalogue of Fundamental Stars*, Davis' *Declinations and Proper Motions of Fifty-six Stars*, and Boss' *Declinations of Fixed Stars.*

In case of all catalogues for which Auwers gives systematic corrections, these have been applied. In other cases such corrections have been derived indirectly through the systems of Newcomb or Boss. Where recourse has been had to other methods, mention of the process is found in the accompanying notes. In some of the recent catalogues the uncorrected places have been employed. For the sake of completeness and uniformity,

however, such corrections have been applied in all cases where they were available, although it would seem that any one who has had occasion to examine somewhat closely into this subject, must agree with Newcomb's conclusion that the correction for systematic errors has in recent times been carried too far.

As the Declinations were reduced in advance of the Right Ascensions, a number of catalogues became available for the latter which were not employed for the former. It is also to be observed that the list embraces several catalogues which give one coordinate only. Where the name is followed by the symbol α, the catalogue has been employed only for the Right Ascensions; when followed by the symbol δ, only for the Declinations.

In the explanatory notes s designates the systematic correction in Right Ascension; s' designates the systematic correction in Declination; p designates the weight of the Right Ascension; p' designates the weight of the Declination; t the mean date of observation. The system of weights employed will be spoken of in connection with the method of reduction.

List of Catalogues.

1. Bradley. 1755. Neue Reduction der Bradley'schen Beobachtungen aus den Jahren 1750 bis 1762. Von Arthur Auwers. St. Petersburg, 1888.
2. Mayer. 1755. Tobias Mayer's Sternverzeichniss nach den Beobachtungen auf der Göttinger Sternwarte in den Jahren 1756 bis 1760. Neu bearbeitet von Arthur Auwers. Leipzig, 1894.
3. Fedorenko's Lalande. 1790. Positions Moyenne pour l'Epoque de 1790,0 des Etoiles Circumpolaire, dont les observations ont été publiées par Jérôme de Lalande dans les Mémoires de l'Académie de Paris de 1789 et 1790. Par Ivan Fedorenko. St. Pétersbourg, 1854. $s = \frac{1}{2}$ (Åbo + Bessel's Bradley); p same as 2; t from Histoire Céleste.
4. Lalande. 1800. A Catalogue of those Stars in the Histoire Céleste Française of Jérôme de Lalande for which tables of reduction to the epoch 1800 have been published by Prof. Schumacher. Francis Baily, Esq. This catalogue was used for a few stars where other early authorities were wanting or doubtful. For declinations the places were taken directly from Baily's Catalogue. $p' = 0.1$. For right ascensions Von Asten's tables were used. p same as 2; t from Histoire Céleste.
5. Bossert (α). 1800. Supplément à l'Histoire Céleste de Lalande. Catalogue de 3950 étoiles ramenées à l'équinoxe de 1800. Par M. J. Bossert. Paris, 1892. p same as 2.
6. d'Agelet. 1800. Reduction of the Observations of Fixed Stars made by Joseph Lepaute d'Agelet at Paris in 1783–1785, with a catalogue of the Corresponding Mean Places referred to the equinox of 1800,0. By B. A. Gould. Washington, 1866.

   $s = 0^s.12$.
   $s' =$ Piazzi $- 1''.42$ 0^h to XII^h.
   $s' =$ Piazzi $+ 1''.22$ XII^h to $XXIV^h$.
   p same as 2.
7. Piazzi. 1800. Præcipuarum stellarum inerrantium Positiones Mediæ Ineunte Sæculo xix ex observationibus habitas in Specula Panormitana ab anno 1792 ad annum 1813. Panormi, 1814. t from original observations. Right ascensions of stars north of 65° declination not used.
8. Groombridge. 1810. A Catalogue of Circumpolar Stars deduced from the observations of Stephen Groombridge at Blackheath Observatory. Edited by George Biddell Airy, Esq. London, 1838.

9. DORPAT (*a*). 1814. F. G. W. Struve. Observationes Astronomicas Institutas in Specula Universitatis Cæsareas Dorpatensis, Vol. I.
10. DORPAT (*a*). 1815. Catalogus I.
11. KOENIGSBERG (*a*). 1815. Bearbeitung von Bessels Beobachtungen am Dollond'schen Mittagsfernrohre in den Jahren 1813–19 Von Dr. Fritz Cohn. Königsberg Beobachtungen, 39 Abtheilung. $s = 0$.
12. WEISSE-BESSEL (δ). 1825. Bessel's Zone observations reduced by Maximillian Weisse. This was used for a few declinations, usually those for which early determiuations were wanting. $p = 0.1$.
13. SCHWERD-OELTZEN (*a*). 1828. The positions were taken from Carrington, No. 43.
14. ÅBO. 1830. DLX, Stellarum Fixarum Positiones Mediæ ineunte anno 1830 ex observationibus Aboæ habitas deduxit. Fredr. Guil. Aug. Argelander. Helsingforsiæ, 1835. *t* from Davis, Ast. Journal, No. 328.
15. PEARSON (δ). 1830. Dr. Pearson's Catalogue of 520 Stars within 6° North and South of the Ecliptic. Memoirs R. A. S., Vol. xv, p. 97. London, 1846. $p' = 0$; 0.1. $s' = 0$.
16. CAMBRIDGE. 1830. Airy's First Cambridge Catalogue. Memoirs R. A. S., Vol. xi. London, 1859.
17. FALLOWS (*a*). 1830. Results of Observations made by the Rev. Fearon Fallows at the Royal Observatory, Cape of Good Hope, in the Years 1829–31. Memoirs R. A. S., Vol. xix, p. 1.
18. POND. 1830. A Catalogue of 1112 Stars from Observations at Greenwich from 1816 to 1833. London, 1833. *t* was obtained from the original observations in Greenwich Yearly Results.
19. STRUVE. 1830. Stellarum Fixarum imprimis duplicium et multiplicium pro epocha 1830. Petropoli, 1852.
20. WROTTESLEY (*a*). 1830. A Catalogue of the Right Ascensions of 1318 Stars. By John Wrottesley, Esq. Memoirs R. A. S., Vol. x.
21. MONTOJO (*a*). 1835. Mean Positions of the Stars contained in "Mr. Baily's Address" as determined at San Fernando. Memoirs R. A. S., Vol. xii, p. 238.
22. MADRAS. 1835. A General Catalogue of the Principal Fixed Stars from Observations made at the Honorable East India Company's Observatory at Madras in the years 1830–43. By Thomas Glanville Taylor. Madras, 1844.
23. RÜMKER. 1836. Mittlere Oerter von 12,000 Fixsternen für den Anfang von 1836, abgeleitet aus den Beobachtungen auf der Hamburger Sternwarte von Carl Rümker. Hamburg, 1852.
24. KÖLLER (*a*). 1838. Extract from a letter from M. Marian Köller, Director of the Observatory at Kremsmünster . . . . accompanying a Catalogue of 208 Stars. Memoirs R. A. S., Vol. xii, p. 373.
25. ARMAGH. 1840. Places of 5345 Stars observed from 1828 to 1854 at the Armagh Observatory. By Rev. T. R. Robinson. Dublin, 1859.
26. SANTINI (δ). 1840. A Catalogue of 1677 Stars included between the Equator and Ten Degrees of North Declination, observed at the Royal Observatory of Padua. By Prof. Giovanni Santini. Memoirs R. A. S., Vol. xii, p. 273. $p' = 0$; 0.1; 0.2.
27. CAPE of Good Hope. 1840. The Cape Catalogue of Stars deduced from observations made at the Royal Observatory, Cape of Good Hope, 1834 to 1840, and reduced to the epoch 1840 under the superintendence of E. J. Stone. Cape Town, 1878.
28. GILLISS (*a*). 1840. Catalogue of Twelve Hundred and Forty-eight Stars observed at Washington between October, 1838, and July, 1842. Washington, 1846.
29. GREENWICH. 1840. Catalogue of 2156 Stars formed from the Observations made from 1836 to 1841 at the Royal Observatory, Greenwich. London, 1849.
30. OELTZEN's Argelander (*a*). 1842. Annalen der K. K. Sternwarte in Wien. Bd. i. Wien, 1851. *s* same as Åbo; *p* same as Rümker; *t* from original zones.
31. GREENWICH. 1845. Catalogue from observations from 1842 to 1847.
32. PARIS. 1845. Catalogue de l'Observatoire de Paris. Étoiles observées aux Instruments Méridiens de 1837 à 1853.
33. POULKOVA (*a*). 1845. Étoiles observées occasionnellement. St. Pétersbourg, 1975.
34. RADCLIFFE. 1845. The Radcliffe Catalogue of 6317 Stars chiefly Circumpolar reduced to the Epoch 1845. Formed from the Observations made at the Radcliffe Observatory under the Superintendence of Manuel John Johnson. Oxford, 1860.

35. Oudemans (δ). 1849. Dissertatio Astronomica Inauguralis exhibens Observationes ope Instrumenti Transitarii partabilis institutas. . . . . Lugdini-Batavorum, 1852.
36. Cape of Good Hope. 1850. Catalogue of 4710 Stars for the Epoch 1850, from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1849 to 1852, under the Direction of Sir Thomas Maclear.
37. Gilliss. 1850. A Catalogue of 1963 Stars and of 290 Double Stars observed by the U. S. Naval Astronomers during the Expedition to the Southern Hemisphere. Appendix i to Washington Yearly Observations for 1868.
38. Greenwich. 1850. Catalogue of 1576 Stars formed from Observations made during Six Years, from 1848 to 1853, at the Royal Observatory, Greenwich.
39. Madras. 1850. A Subsidiary Catalogue of 1440 Stars selected from the British Association Catalogue, reduced to Jan. 1, 1850, from Observations made at Madras in the Years 1849–53. Madras, 1854.
40. Rümker. 1850. Neue Folge der mittleren Oerter von Fixsternen für den Anfang von 1850, abgeleitet aus den Beobachtungen auf der Hamburger Sternwarte von Carl Rümker. Hamburg, 1852–59.
41. Sonntag (a). 1850. Mittlere Oerter für 1850 von Vergleichsternen zum Cometen I 1850. Ast. Nach., Bd. xxxiv. p same as 32 ; $s = .050$.
42. Wrottesley (a). 1850. A Catalogue of the Right Ascensions of 1009 Stars contained in the Catalogue of the British Association for the Advancement of Science. . . . . By Lord Wrottesley. Memoirs R. A. S., Vol. xxiii.
43. Carrington. 1855. A Catalogue of 3735 Circumpolar Stars observed at Redhill in the years 1854, '55 and '56 and reduced to the Mean Position for 1855. By Richard Christopher Carrington. p same as 13.
44. Madras. 1855. A Catalogue of 317 Stars . . . . deduced from Observations at Madras. Memoirs R. A. S., Vol. xxii.
45. Moesta. 1855. Observaciones Astronómicas hechas en el Observatorio Nacional de Santiago de Chile en los Añas de 1853, 1854 y 1855. Vol. i. Santiago, 1859.
46. Moscow. 1855. Catalogue des étoiles observées par M. Drachoussoff. Annales de l'Observatoire de Moscow, Vol. vi. s same as Nautical Almanac ; p same as 53.
47. Poulkova. 1855. Positions Moyenne déduites des observations faites au cercle méridien 1840–1859 et réduites à l'époque 1855, 0. Observations de Poulkova, Vol. viii. St. Pétersbourg, 1859.
48. Cape of Good Hope. 1860. The Cape Catalogue of 1159 Stars, deduced from Observations by Sir Thomas Maclear at the Royal Observatory, Cape of Good Hope, 1856 to 1861. Cape Town, 1893.
49. Santini (δ). 1860. Posizioni Medie di 1,425 Stelle, dedotte dal osservazioni fatte dal defunto Prof. Trettenero 1861–65. Venezia, 1870. $p' = 0$; 0.1 ; 0.2.
50. Greenwich. 1860. Seven Year Catalogue of 2022 Stars deduced from Observations extending from 1854 to 1860 at the Royal Observatory, Greenwich.
51. Moscow. 1860. Resultate aus der Zonen-Beobachtungen am Meridian Kreise der Moskauer Sternwarte während der Jahre 1858-69. I Zone 0°–4°. Memoirés de l'Académie Impériale des Sciences de St. Pétersbourg, viii Série : Classe Physico-Mathematique, Vol. I, No. 5. s same as Poulkova, 1855 ; p same as 53.
52. Paris. 1860. Catalogue de l'Observatoire de Paris. Etoiles observée de 1854 à 1867.
53. Radcliffe, 1860. Second Radcliffe Catalogue, containing 2386 Stars deduced from observations extending from 1854 to 1861 . . . . Oxford, 1870.
54. Yarnall. 1860. Catalogue of Stars observed at the United States Naval Observatory during the years 1845 to 1877. Third edition revised. . . . . Washington, 1889.
55. Poulkova (δ). 1862. Observations faites à l'Instrument des passages établi dans le Premier Vertical. Oom. Observations de Poulkova, Vol. iii, pp. 223–238.
56. Greenwich. 1864. New Seven Year Catalogue of 2760 Stars, deduced from Observations extending from 1861 to 1867 at the Royal Observatory, Greenwich.
57. Brussels. 1865. Catalogue de 10,792 Étoiles observée à l'Observatoire Royal de Bruxelles de 1857 à 1878 . . . . Par Ernest Quetelet, Bruxelles, 1887.

58. Poulkova (α). 1865. Ascensions droites Moyenne des étoiles occasionnellement observées pour 1865,0. Observations de Poulkova, Vol. xii.

59. Schjellerup(α). 1865. Stjernefortegnelse indeholdende 10,000 Positioner af Teleskopiske Fixstjerner imellem — 15 og + 15 Gradus Deklination. Kjøbenhavn, 1864. s same as Nautical Almanac interpolated as follows*: $s = 1860 + \frac{7}{15}$ (1875–1860) ; p same as 53.

60. Glasgow. 1870. Catalogue of 6415 Stars for the Epoch 1870, deduced from Observations made at the Glasgow University Observatory during the Years 1860 to 1881 . . . . By Robert Grant. Glasgow, 1883.

61. Melbourne. 1870. First Melbourne General Catalogue of 1227 Stars for the Epoch 1870 deduced from Observations extending from 1863 to 1870, made at the Melbourne Observatory. Melbourne, 1874.

62. Greenwich. 1872. Nine Year Catalogue of 2263 Stars deduced from Observations extending from 1868 to 1876, made at the Royal Observatory, Greenwich.

63. Astronomische Gesellschaft Zones. 1875. These include all of this series of catalogues published, together with the places of those stars found in the Leyden, Lund and Dorpat Zones, those of the earlier and later Lund Zones being combined separately. p is taken the same as Paris, '75 ; $p' = 1$. throughout the series.

64. Armagh. 1875. Second Armagh Catalogue of 3300 Stars for the Epoch 1875, deduced from Observations made at the Armagh Observatory during the Years 1859 to 1883. . . . . Dublin, 1886. p same as 60.

65. Becker. 1875. Resultate aus Beobachtungen von 521 Bradley'schen Sternen am grossen Berliner Meridiankreise von Dr. E. Becker. Berlin, 1881.

66. Cordoba. 1875. Catálogo General Argentino. Cordoba, 1886.

67. Dunsink. 1875. Mean Places of 321 Red Stars deduced from Observations made with the Meridian Circle at Dunsink. . . Dublin, 1882. $s = 0$; p same as Paris, '75.

68. Washington. 1875. The Second Washington Catalogue of Stars . . . . prepared under the Direction of J. R. Eastman.

s obtained through Newcomb's system.

$s' = -0''.33$	from $\delta =$	0 to $\delta =$	40°
$= \quad .00$		40°	50°
$= + \quad .09$		50°	90°

69. Göttingen. 1875. Mittlere Oerter der in der Zonen — 0° und — 1° der Bonner Durchmusterung enthaltenen Sterne. . . . Göttingen, 1869. s same as for Nautical Almanac as follows : $s = s_{1860} + \frac{8}{15}$ ($s_{1875} - s_{1860}$) ; p same as Glasgow, '70.

70. Harvard. 1875. Catalogue of Primary and Secondary Stars observed during the years 1870–1879 with the Meridian Circle of the Harvard College Observatory. Cambridge, 1886.

71. Paris. 1875. Catalogue de l'Observatoire de Paris. Étoiles observée de 1868 à 1881.

72. Poulkova. 1875. Catalog von 5634 Sternen für die Epoche 1875.0 aus den Beobachtungen am Pulkowaer Meridiankreise während der Jahre 1874–1880 von H. Romberg. St. Pétersbourg, 1891.

73. Stockholm. 1875. Results of meridian observations found in the first five volumes of the publications of the Stockholm Observatory. p same as Paris, '75.

74. Respighi (δ). 1875. Catalogo delle Declinazione Medie pel 1875.0 di 1463 Stelle comprese fra i paralleli 20° e 64° nord. . . . . Roma, 1880.

75. Cape of Good Hope. 1880. Catalogue of 12,441 Stars for the Epoch 1880 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1871 to 1879. By Edward J. Stone. London, 1881.

76. Greenwich. 1880. Ten Year Catalogue of 4059 Stars, deduced from Observations extending from 1877 to 1886 at the Royal Observatory, Greenwich.

77. Melbourne. 1880. Second Melbourne General Catalogue of 1211 Stars for the Epoch 1880, deduced from Observations extending from 1871 to 1884, made at the Melbourne Observatory. Melbourne, 1889.

78. Respighi (δ). 1880. Catalogo delle Declinazione Medie pel 1880,0 di 1004 Stelle di 1ª in 6ª grandezza comprese fra 0° e 20° nord, e 64° e 90° nord. . . . . Roma, 1885.

79. Munich (α). 1880. Erster Münchener Sternverzeichniss erhaltend die Mittleren Oerter von 33,082 Sternen. München, Neue Annalen, Bd. i. p same as 60.

80 De Ball (δ). 1880. Declinationen von 200 Sternen innerhalb der Zone + 49° bis 51°, nach Beobachtungen im ersten Vertical am Passagen-instrumente der Herzoglichen Sternwarte zu Gotha. Ast. Nach., Bd. ci, 353.

81. Cape of Good Hope. 1885. Catalogue of 1713 Stars for the Equinox 1885,0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1879 to 1885.

82. Harzer. 1885. Resultate aus Beobachtungen am Meridiankreise der Herzoglichen Sternwarte zu Gotha. Ast. Nach., Bd. cxxvii, 170. $s = 0$; $p = \frac{1}{2}$ that of 76.

83. Kasan (δ). 1885. Les Observations faites à l'instrument des passages établi dans le premier vertical. Kasan Observations for 1893.

84. Karlsruhe. 1885. Lists found in the first four volumes of the publications of the observatory. $s = 0$; p same as Radcliffe, '60.

85. Washburn (δ) '84, '85. 1885. Publications of the Washburn Observatory, Vol. iv.

86. Safford (α). 1885. The Williams College Catalogue of North Polar Stars. Williamstown, Mass., 1888.

87. Nyrén (δ). 1887. Declinationsbestimmungen einiger Helleren Sterne zwischen + 18° und + 26° am Pulkowaer Verticalkreise. A. N., No. 2904, Bd. 121.

88. Cape of Good Hope. 1890. A Catalogue of 3007 Stars for the Equinox 1890 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1885 to 1895.

89. Cincinnati. 1890. A Catalogue of 2000 Stars for the Epoch 1890. Publications of the Cincinnati Observatory, No. 13. p same as Paris 75.

90. Dunsink. 1890. Mean places of 717 Stars deduced from Observations made with the Meridian Circle at Dunsink. Dublin, 1896. $s = 0$; p same as 71.

91. Glasgow. 1890. Second Glasgow Catalogue of 2156 Stars for the Epoch 1890 deduced from Observations made at the Glasgow University Observatory during the Years 1886 to 1892. Glasgow, 1892.

92. Küstner. 1890. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 2. $s = 0$.

93. Radcliffe. 1890. Catalogue of 6424 Stars for the Epoch 1890. Formed from Observations made at the Radcliffe Observatory, Oxford, during the Years 1880–1893.

94. Battermann. 1895. Resulte aus Beobachtungen von 379 Anhaltsternen und 1640 durch Anschluss bestimmten Sternen, angestellt in den Jahren 1892–1897 am Grossen Berliner Meridiankreise von Dr. H. Battermann. Berlin, 1899. $s = 0$.

95. Cincinnati. 1895. Catalogue of 2030 Stars for the Epoch 1895. Publications of the Cincinnati Observatory, No. 14. $s = 0$; p same as 71.

96. Tucker (α). 1895. Meridian Circle Observations of 310 Standard Stars. Publications of the Lick Observatory, Vol. iv. Sacramento, 1900.

97. Tucker (δ). 1897. The entire list of stars was very carefully observed by R. H. Tucker, of the Lick Observatory, in the years 1896 and 1897. It was intended to publish the results of these observations in full in this connection, but the preparation of this work has been so long delayed that it now appears superfluous, in view of the fact that a much more detailed report than could be given here will appear in a forthcoming publication of the Lick Observatory. The following note is by Mr. Tucker:

"Each star was observed twice in each position of the instrument, fixed circle East and West, and "the greater part of the stars above 70° were similarly observed at both culminations.

"The places were reduced with the Declinations from the catalogue of Louis Boss, *Declinations of "Fixed Stars, U. S. Northern Boundary Commission*, 1879.

"The probable error of a single observation is $\pm 0''.18$. The probable error of observation for the "mean of four, in the two positions is $\pm 0''.12$, including the effect of graduation error."

The reduction to Auwers' system has been applied and the results have been employed with a uniform weight of 3.

98. Wirtz (δ). 1900. Bestimmung der Deklinationen von 487 Sternen und der Polhöhe der Bonner Sternwarte aus Beobachtungen . . . . im Ersten Vertical. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 3.

99. DUNSINK. 1900. Mean Places of 1101 Stars deduced from Observations made with the Meridian Circle at Dunsink. Dublin, 1899. *p* same as Paris, '75.

100. KÜSTNER (*α*). 1900. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 4.

Yearly Series.

101. 1835–1869. EDINBURGH. Astronomical Observations at the Royal Observatory, Edinburgh.

102. 1836–1869. CAMBRIDGE. Astronomical Observations made at the Observatory of Cambridge.

103. 1862–1876. RADCLIFFE. Results of Astronomical Observations made at the Radcliffe Observatory.

104. 1862–1887. MADRAS. Meridian Circle Observations.

105. 1879–1882 (*α*). BRUSSELS. Annales de l'Observatoire Royal de Brusselles, Nouvelle Series. *s* same as Nautical Almanac; *p* same as 57.

106. 1887–1896. GREENWICH. Annual volumes.

Method of Reduction.

Approximate positions for 1875 were obtained from whatever source was available. Many of these were the result of a previous reduction, and with very few exceptions the assumed places differed from the final values only by fractions of a second. The assumed proper motions were in part the result of a previous reduction, others were taken from Auwers' Bradley and other sources.

These assumed coordinates were then reduced to the epoch of the various catalogues in which the star was found, using for this purpose the formula

$$\alpha = \alpha_{1875} + \left[\frac{d\alpha}{dt}\right](\tau - 1875) + \tfrac{1}{2}\left[\frac{d^2\alpha}{dt^2}\right](\tau - 1875)^2 + \tfrac{1}{6}\left[\frac{d^3\alpha}{dt^3}\right](\tau - 1875)^3$$

α being the Right Ascension or Declination of any star.

τ the epoch of the catalogue.

The formulæ for the differential coefficients for the epoch 1875, using the constants of Struve and Peters, are as follows, in which

α = the Right Ascension.

δ = the Declination.

μ = the Proper Motion in Right Ascension.

μ' = the Proper Motion in Declination.

$$\frac{d\alpha}{dt} = 3.^s07225 + [0.126115] \sin\alpha \tan\delta + \mu.$$

$$\frac{d\delta}{dt} = [1.302206] \cos\alpha + \mu'.$$

$$\frac{d\mu}{dt} = [5.988]\, \mu \cos\alpha \tan\delta + [4.812]\, \mu' \sin\alpha \sec^2\delta + [4.99]\, \mu\, \mu' \tan\delta.$$

$$\frac{d^2\alpha}{dt^2} = [4.63380_n]\left(\frac{da}{dt} - \mu\right) + [5.98778]\left(\frac{da}{dt} + \mu\right)\cos\alpha \tan\delta + [4.81169]\left(\frac{d\delta}{dt} + \mu'\right)\sin\alpha \sec^2\delta + [4.9866]\, \mu\, \mu' \tan\delta + 0.^s000\,032\,210.$$

$$\frac{d^2\delta}{dt^2} = [4.63380_n]\left(\frac{d\delta}{dt} - \mu'\right) + [7.16387_n]\left(\frac{da}{dt} + \mu\right)\sin\alpha + [6.7367_n]\, \mu^2 \sin 2\delta.$$

$$\frac{d^3\delta}{dt^3} = [2.0987]\left(\frac{da}{dt} + \frac{\mu}{2}\right)\sin\alpha + [7.1639_n]\left(\frac{d^2\alpha}{dt^2} + \frac{d\mu}{dt}\right)\sin\alpha + [3.0255_n]\left(\frac{da}{dt} + \mu\right)\frac{da}{dt}\cos\alpha.$$

The numbers enclosed in brackets are logarithms.

For $\frac{d^3a}{dt^3}$ the Right Ascension and Declination were reduced to 1825 and 1925, using for this purpose the first and second differential coefficients already computed. $\frac{d^2a}{dt^2}$ was then derived for these dates, the differences giving $\frac{d^3a}{dt^3}$ with all necessary precision. For checking these values the tables given by Gould* were employed from 0^h to 12^h, neglecting proper motion. From 12^h to 24^h the tables of Oppolzer† were similarly used.

As already stated the catalogue places were reduced to Auwers' system whenever the necessary corrections were available. A correction for proper motion was also applied in all cases where the necessary data could be found.

Let τ be the epoch of the catalogue,

t the mean date of observation, usually different from τ,

μ'' the proper motion employed in forming the catalogue,

μ the proper motion assumed in this discussion,

The correction will be $(\tau - t)(\mu - \mu'') = \delta_\mu a$.

It is perhaps superfluous to state that both t and μ'' are unknown in case of many of the older catalogues.

Let n be the difference between the corrected catalogue place and the assumed place, reduced as above explained to the epoch of the catalogue,

Then each catalogue furnishes an equation of the form

$$\sqrt{p}(\Delta\alpha + T\Delta\mu = mn)$$

In which p is the weight of the catalogue place,

$\Delta\alpha$ the correction to the assumed Declination, or Right Ascension,

$\Delta\mu$ the correction to the assumed proper motion,

$T = 1875 - t$.

A least square solution gives the most probable values of $\Delta\alpha$ and $\Delta\mu$.

The method of solving the equations is one very commonly employed in cases like this and is as follows:

Let t_0 be the weighted mean of the catalogue epochs, or of the epoch of observation when this differs from that of the catalogue,

t_1, t_2 $\quad t_n$ the epochs of the respective catalogues,

T_1, T_2 $\quad T_n = (t_1 - t_0)$, $\quad (t_2 - t_0)$ $\quad (t_n - t_0)$

ΣpT should be zero.

* *Catálogo de Las Zonas Estelares,* Appendix, Table iv, Cordoba, 1884. In using this table it must be remembered that the value of p^3 as given in column four should be doubled. See *Ast. Nach.*, Bd. 137, p. 295.

† *Lehrbuch zur Bahnbestimmung der Kometen und Planeten,* Vol. i, Table XII.

Then we have

$$\Delta\alpha = \frac{\Sigma pn}{\Sigma p} \qquad \Delta\mu = \frac{\Sigma pTn}{\Sigma pT^2}$$

Check $\Sigma pvv = \Sigma pnn - (\Sigma pn)\,\Delta\alpha - (\Sigma pTn)\,\Delta\mu$

$\Delta\alpha$ for 1875 will be the above $\Delta\alpha + (1875 - t_0)\,\Delta\mu$.

An example follows which will illustrate the various steps in the process:

Star.
B A C 3140

Assumed Coordinates and proper motion for 1875.0.
$\alpha = 9^h\ 7^m\ 10^s.87 \quad \mu = +.0056$
$\delta = 54^\circ\ 32'\ 11''.15 \quad \mu' = +.068$

	Catalogue.	τ	t	*No. Obs.*	μ''	n	p	pt	pn	T	pT	pTn	pT^2	v
1	Bradley	1755	54.2	3	+.0056	—0.009	.3	—13.74	—0.0027	—103.22	—30.97	+0.2790	+3199.20	—0.063
2	Piazzi	1800	04.83	9		+0.261	.08	+ 0.39	+0.0209	— 52.59	— 4.21	—1.0962	220.92	—0.300
3	Groombridge	1810	08.8	6		—0.244	.2	1.76	—0.0488	— 48.62	— 9.72	+2.3668	471.42	+0.208
4	Dorpat	1814	14.11	2		—0.212	.2	2.82	—0.0424	— 43.31	— 8.66	+1.8444	376.71	+0.179
5	Pond	1830	31.54	13		+0.070	.4	12.62	+0.0280	— 25.88	—10.35	—0.7280	269.36	—0.091
6	Madras	1835		11		+0.042	.3	10.50	+0.0126	— 22.42	— 6.73	—0.2814	150.08	—0.061
7	Rümker	1836		6		—0.040	.2	7.20	—0.0080	— 21.42	— 4.28	+0.1720	92.02	+0.022
8	Armagh	1840	34.74	2		+0.006	.1	3.47	+0.0006	— 22.68	— 2.27	—0.0138	52.21	—0.025
9	Gilliss	1840	41.85	1	+.011	—0.010	.05	2.09	—0.0005	— 15.57	— 0.78	+0.0080	12.48	—0.005
10	Edinburgh	1842	42.18	5		+0.225	.5	21.09	+0.1125	— 15.24	— 7.62	—1.7100	115.52	—0.239
11	Oeltzen's Arg'er	1842	42.12	1		—0.118	.05	2.11	—0.0059	— 15.30	— 0.77	+0.0944	12.24	+0.104
12	Greenwich	1845	44.87	6	+.011	—0.186	.7	31.41	—0.1302	— 12.55	— 8.79	+1.6368	110.88	+0.173
13	Radcliffe	1845	47.9	7	+.004	+0.103	.9	43.11	+0.0927	— 9.52	— 8.57	—0.8858	81.70	—0.114
14	Paris	1845	41.6	18		—0.043	1.1	45.76	—0.0473	— 15.82	—17.40	+0.7482	274.92	+0.028
15	Poulkova	1855	47.80	5	+.0056	—0.086	1.0	47.80	—0.0860	— 9.62	— 9.62	+0.8256	92.16	+0.075
16	Greenwich	1860	59.5	3	+.004	—0.013	.9	53.55	—0.0117	+ 2.08	+ 1.87	—0.0247	3.99	+0.010
17	Radcliffe	1860	59.2	4	+.004	—0.003	.4	23.68	—0.0012	+ 1.78	+ 0.71	—0.0021	1.26	.000
18	Yarnall	1860	72.5	4		—0.112	.7	50.75	—0.0784	+ 15.08	+10.56	—1.1872	160.06	+0.117
19	Brussells	1865	66.00	4		+0.032	1.1	72.60	+0.0352	+ 8.58	+ 9.44	+0.3008	80.84	—0.031
20	A. G. Zones	1875	75.2	2		—0.131	.3	22.56	—0.0393	+ 17.78	+ 5.33	—0.6943	94.34	+0.138
21	Paris	1875	81.2	2		+0.039	.3	24.36	+0.0117	+ 23.78	+ 7.13	+0.2769	168.98	—0.028
22	Stockholm	1875	75.53	3		—0.130	.4	30.21	—0.0520	+ 18.11	+ 7.24	—0.9360	130.32	+0.137
23	Madras	1878.40	78.61	5		+0.098	.5	39.31	+0.0490	+ 21.19	+10.60	+1.0388	224.72	—0.089
24	Greenwich	1880	84.24	7	+.0056	+0.045	2.9	+244.30	+0.1305	+ 26.82	+77.78	+3.5010	2085.04	—0.032
							13.58 Σp	779.71 Σpt	—0.0607 Σpn		— 0.08 ΣpT	+5.5322 ΣpTn	+8481.37 ΣpT^2	

$$t_0 = \frac{779.71}{13.58} = 57.42$$

Weighed mean date = 1857.42

$$\Delta\alpha = \frac{-0.0607}{13.58} = -0.^s0045$$

$$\Delta\mu = \frac{5.5322}{8481.37} = +0.^s00065$$

$$\Delta\alpha_{1875} = -0.0045 + \left(0.00065 \times (1875 - 1857.42)\right) = +0.0069$$

Assumed α	9^h	7^m	$10^s.87$
Final value	9^h	7^m	$10^s.877$

Assumed μ	$+0.^s0056$
Final value	$+0.00625$

Σpv^2	=	0.1277
Σpn^2	=	0.1315
$-(\Sigma pn)\ \Delta\alpha$	=	—0.0003
$-(\Sigma pT^2)\ \Delta\mu$	=	—0.0036
Check		0.1276

Weights.

In case of the Right Ascensions the weights have been taken from Auwers' values, *Astronomische Nachrichten*, Bd. 151, for all authorities found there. For other cases the attempt has been made to conform as closely to this system as practicable.

For the Declinations the system of weights is nearly the same as that given by Davis.* The most noticeable differences between the weights here employed and those of Newcomb are, first, the greater value assigned by Newcomb to the Poulkova and Washington catalogues; and second, in general the greater increase in weight corresponding to an increase in the number of observations. This last feature is not usually very conspicuous in the present discussion, as there are comparatively few cases where the number of observations is large. For the purpose of comparison the weights assigned by Newcomb to the authorities employed in the above example are given below, together with such as are given by Boss† in connection with his investigation.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Wght. here used	.6	.3	.0	.6	1.0	.5	.5	.3	.5	3.0	.0	3.0	2.0	2.0	2.0	1.0	1.5	2.0	1.0	1.0	1.0	1.5	.3	1.5	2.0	1.0	3.0
Newcomb	.5			.4	1.0					3.0		4.0			5.0	1.5	2.5								2.5		2.0
Boss		.1		.3	.8	.2		.6	.3	1.5		2.5	.6	1.0	3.0	1.0	.7	3.0	1.5								

This comparison will illustrate the different conclusions which have been reached as to the relative merits of some of the authorities. It is not claimed that the weights here employed are in all cases the best, but the effort has been made to follow a consistent system throughout in order to reach results which shall be so far as possible homogeneous.

The Star List.

The list of 254 latitude stars which follows includes 74 which are found in Newcomb's new Fundamental Catalogue. The places of these have been taken directly from that publication, applying the reduction to Auwers' system as explained below. Polaris is an exception, the position being taken without change from Newcomb. There are also three stars given in Davis' paper before referred to.—*The Declinations and Proper Motions of Fifty-six Stars*—the declinations of these have been taken from that publication.

The coordinates of the remaining stars—180 right ascensions and 177 declinations—have been derived as explained in the preceding pages.

As Newcomb's system is no doubt preferable to that of Auwers' for the reason that

* *Declinations and Proper Motions of Fifty-six Stars*, pages 14-18.

† *Declinations of the Fixed Stars, Report of the U. S. Northern Boundary Commission*, Appendix ii.

it represents more closely the actual state of the celestial sphere, it is very desirable that we should be able to refer our coordinates to that system. This may be very readily done by employing the formulæ and tables given by Newcomb for passing from one system to the other. These are reproduced here for the convenience of any wishing to make the change. The reduction of the declinations to the system of Boss is also included.

In what follows N refers to the system of Newcomb,

A refers to that of Auwers.

On page 156 of Newcomb's memoir is given for the difference of the Equinoxes

$$N = A + {}^s.006 + {}^s.00100\,(T - 1875)$$

Combining this with the difference depending on the Declinations, page 165, the reduction in Right Ascension for any time T has the form

$$N = A + \Delta\alpha + \Delta\mu\,\frac{(T - 1875)}{100}$$

with a similar expression for the Declination.

In the table, divisions A and B give the data for reducing the Right Ascensions and Declinations respectively from the system of Auwers to that of Newcomb; C for reducing the declinations to the system of Boss.

Declination.	A		B		C	
	$\Delta\alpha$	$\Delta\mu$	$\Delta\delta$	$\Delta\mu'$	$\Delta\delta$	$\Delta\mu'$
	s	s	″	″	″	″
+ 85°			— .00	+ .37	— .04	+ .30
80	— .017	+ .119	+ .03	+ .45	— .07	+ .30
75	— .008	+ .127	+ .04	+ .46	— .10	+ .27
70	— .000	+ .129	+ .02	+ .32	— .13	+ .10
65	+ .004	+ .127	+ .03	+ .27	— .14	— .00
60	+ .005	+ .124	+ .09	+ .26	— .10	— .10
55	+ .005	+ .123	+ .19	+ .32	— .04	— .10
50	+ .002	+ .128	+ .22	+ .36	+ .04	— .10
45	— .014	+ .111	+ .30	+ .09	+ .07	— .35
40	— .012	+ .109	+ .32	— .72	+ .08	— 1.20
35	— .009	+ .096	+ .29	— .86	+ .06	— 1.33
30	— .004	+ .090	+ .26	— .81	+ .05	— 1.22
25	+ .004	+ .091	+ .24	— .85	+ .06	— 1.18
20	+ .006	+ .093	+ .24	— .94	+ .09	— 1.27
15	+ .009	+ .094	+ .31	— 1.00	+ .15	— 1.36
10	+ .011	+ .098	+ .36	— .98	+ .18	— 1.31
+ 5	+ .012	+ .103	+ .36	— .92	+ .19	— 1.24
0	+ .012	+ .108	+ .39	— .80	+ .20	— 1.16
— 5	+ .012	+ .113	+ .42	— .75	+ .23	— 1.14
— 10	+ .010	+ .113	+ .55	— .80	+ .34	— 1.25
— 15	+ .010	+ .115	+ .74	— .72	+ .48	— 1.30
— 20	+ .009	+ .116	+ .89	— .54	+ .58	— 1.30
— 25	+ .009	+ .125	+ .99	— .44	+ .66	— 1.40

The reduction for proper motion is the second term in each of the above expressions. For example, for Declination 80°

$$\mu_N = \mu_A + .00119\ (T - 1875)$$

$$\mu'_N = \mu'_A + .0045\ \ (T - 1875)$$

$$\mu'_B = \mu'_A + .0030\ \ (T - 1875)$$

The results of a direct comparison of the stars common to the catalogues of Newcomb and Auwers will be found in No. 3742, *Astronomische Nachrichten*, in an article by Dr. Fritz Cohn entitled "Vergleichung des Newcomb'schen Fundamenentalcatalogs mit dem Auwers'schen A. G. C."

In the pages which follow the column headed *B. A. C.* gives the number corresponding to the star's place in the British Association Catalogue, with the exception of five not found in that publication. The magnitudes are from various sources and do not claim great precision. The column headed *A* gives the number of authorities employed in deducing the corresponding coordinate. Where N or D occurs in this column it implies that the corresponding coordinate is taken from Newcomb or Davis, as the case may be.

The differential coefficients include the proper motions μ and μ' in accordance with the formulæ given on page 9.

To illustrate the reduction to any epoch, let the Right Ascension and Declination of No. 3 be required for 1755:

$$1755 - 1875 = -120$$

Therefore

$$\alpha_{1755} = 0^h\ 10^m\ 33^s.963 - 120 \times 3^s.11489 + \tfrac{1}{2}\ (120)^2 \times 0^s.0002643 + 0^s.019 \times (-1.20)^3.$$
$$= 0^h\ 4^m\ 22^s.046$$
$$\delta_{1755} = 37^\circ\ 59'\ 14''.89 - 120 \times 20''.0272 + \tfrac{1}{2}\ (120)^2 \times (-0''.000295) - 0''.175 \times (-1.20)^3$$
$$= 37^\circ\ 19'\ 9''.80$$

Auwers' Bradley gives

$$\alpha = 0^h\ 4^m\ 22^s.08$$
$$\delta = 37^\circ\ 19'\ 10''.0$$

Definitive Positions 1875.0.

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ'	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
1	16	5.1	0 3 49.785	+ 3.09580	+.0003283	+ .025	+.00092	45 22 35.55	+20.0460	—.000162	— .171	—.0054		N
2	LL 220	7.5	10 12.247	3.12214	2468	.017	+.00069	35 47 41.51	20.0845	289	.174	+.0501	9	11
3	52	5.	10 33.963	3.11489	2643	.019	—.00547	37 59 14.89	20.0272	295	.175	—.0057	23	26
4	*60	6.2	12 7.151	3.13969	3169	.023	+.00133	43 5 48 13	20.0200	328	.178	—.0062	19	19
5	99	6.5	21 28.282	3 11329	1350	.011	—.00159	18 49 21.31	19.9573	510	.173	—.0090	16	18
6	126	4.2	0 25 54.538	+ 3 35929	+ 7016	+ .070	+.00049	62 14 29.79	+19.9212	— 639	— .217	—.0050		N
7	194	5.6	37 25.783	3.83965	16084	.270	—.00617	74 18 15.76	19.7567	994	.319	—.0307		N
8	222	4.6	43 11.898	3.10632	785	.009	+.00444	6 54 15.47	19.6803	915	.170	—.0349		N
9	259	3.9	49 49.230	3.30819	3068	.018	+.01211	37 49 14.99	19.6203	1129	.204	+.0380		N
10	318	5.0	1 00 50.736	3.41633	3822	.022	+.01410	43 16 31.70	19.2915	1396	.223	—.0602	20	22
11	361	7.	1 6 30.266	+ 3.01720	+ 186	+ .009	—.00504	— 7 26 49.97	+19.1745	— 1340	— .153	—.0413	15	16
12	394	6.7	12 45.553	3 93545	9621	.085	+.00744	64 0 6.49	19.0228	1877	.331	—.0293	17	18
13	360	2.	12 59.80	20.8603	15057		+.1229	88 38 33.81	19.0457	9659		+.0051		N
14	413	6.7	17 7.878	3.21167	1538	.009	+.00304	17 9 58.18	18.8985	1630	.182	—.0307	13	12
15	438	6.0	21 57.528	4.35677	14364	.157	+.02478	69 37 13.22	18.7107	2318	.436	—.0748		N
16	459	7.0	1 25 55.826	+ 3.17059	+ 1217	+ .008	+.00105	11 14 19.72	+18.6672	— 1774	— .174	+.0061	12	12
17	480	4.2	29 28.033	3.49478	3635	.016	—.01629	40 46 45.47	18.1746	2010	.230	—.3709		N
18	502	4.9	33 12.472	3.51639	3603	.016	+.00127	39 56 35.06	18.3968	2109	.233	—.0217		N
19	592	5.8	50 31.460	3.26527	1637	.007	+.00101	17 12 22.78	17.7500	2286	.182	—.0171	32	32
20	611	5.6	53 46.264	4.36499	10502	.070	—.00047	63 47 5.72	17.6345	3107	.414	+.0010		N
21	656	3.1	2 2 6.635	+ 3.54883	+ 3043	+ .009	+.01168	34 23 41.61	+17.2389	— 2712	— .226	—.0355		N
22	706	6.	11 13.393	3.83707	4751	.014	—.00658	46 48 6.64	16.8415	3099	.277	—.0143	18	21
23	744	4.6	18 47.640	4.84970	13108	.077	—.00157	66 50 19.39	16.4952	4096	.518	+.0074		N
24	780	6.5	26 3.504	3.27527	1508	.004	—.00241	14 28 47.55	16.1580	2910	.170	+.0402	25	23
25	816	6.5	34 6.927	4.24693	6562	.015	+.00409	54 34 14.64	15.6597	3929	.344	—.0286	16	18
26	872	3.7	2 42 37.769	+ 3.51532	+ 2274	+ .002	+.00414	26 44 37.80	+15.1107	— 3410	— .197	—.1028		N
27	916	6.0	51 35.637	3.84960	3616	.001	—.00082	40 31 59.00	14.6504	3884	.250	—.0405	8	10
28	963	V.	3 0 2.496	3.87871	3554	.000	—.00031	40 28 20.47	14.1824	4061	.244	+.0045		N
29	981	5.0	3 13.561	3.84883	3368	— .001	—.00340	39 8 6.03	13.9878	4081	.234	+.0083	20	22
30	993	6.0	6 39.454	3.95407	3713	— .001	+.00518	42 2 5.78	13.7791	4259	.249	+.0164	14	17
31	1050	6.5	3 17 24.064	+ 6.09182	+ 17880	+ .020	+.00106	71 25 31.49	+13.0686	— 6798	— .747	+.0046	12	13
32	1068	3.8	20 23.777	3.24316	1167	.000	+.00305	9 17 43.01	12.8274	3687	.136	—.0366		N
33	1119	6.4	32 21.681	3.38265	1421	— .002	+.00128	16 7 42.19	12 0132	3998	.143	—.0304	23	22
34	1144	4.6	38 5.857	5.41987	10153	.026	—.00185	65 8 12.27	11.6256	6485	.493	—.0130	18	18
35	1221	6.0	49 29.036	3.53321	1598	.005	+.00340	22 6 57.66	10.7081	4390	.146	—.1052	31	28
36	1237	4.9	3 54 2.951	+ 4.95181	+ 6417	— .032	—.00335	58 48 19.96	+10.4740	— 6199	— .351	—.0006	14	18
37	1274	5.8	4 1 53.137	3.48607	1379	.006	+.00697	19 16 36.53	9.8497	4475	.129	—.0342		N
38	1286	5.6	5 53.405	5.23925	6978	.048	+.00063	61 31 58.83	9.5639	6755	.371	—.0136	13	16
39	1307	5.6	9 50.643	4.47574	3766	.026	+.00359	49 44 29.36	9.2099	5832	.237	—.0623	13	16
40	1364	6.5	18 9.030	3.80681	1792	.012	+.00483	31 9 16.66	8.5057	5056	.142	—.1161	17	17
41	1425	6.0	4 30 4.391	+ 4.70174	+ 3678	— .039	+.00035	52 49 39 86	+ 7.6519	— 6369	— .223	—.0166	16	16
42	1444	5.9	33 30.448	3.74561	1457	.012	+.00218	28 22 14.07	7.3602	5113	.117	—.0298	19	18
43	1486	3.3	43 3.312	3.25165	722	.005	+.03020	6 44 27.92	6.6416	4548	.072	+.0345		N
44	1496	6.0	46 30.153	7.52098	13291	.292	+.00303	74 4 17.30	6.3515	10441	.606	+.0298	11	16
45	1536	4.2	52 18.315	5.30905	4186	.077	—.00165	60 15 22.91	5.8237	7430	.232	—.0140		N
46	1555	7.0	4 56 54.749	+ 3.56872	+ 921	— .011	+.00001	21 6 1.57	+ 5.4353	— 5032	— .076	—.0156	16	16
47	1568	5.3	5 0 3.774	3.54044	836	.010	+.03669	18 28 30.56	5.2123	5062	.070	+.0272	38	38
48	1583	6.7	1 53.740	5.55689	4176	.096	—.00509	62 33 1.37	5.0380	7859	.224	+.0079	13	16
49	1598	6.8	6 30.813	9.34113	17142	.728	—.00238	78 16 57.33	4.6398	13270	.743	+.0019	12	12
50	*1611	5.0	5 6 45.382	3.13271	513	.005	—.00113	2 42 37.77	4.6206	4464	.046	+.0034	20	19
51	*1625	7.0	5 9 25 519	+ 3.50302	+ 725	— .010	—.00060	18 17 52.85	+ 4 3856	— 5003	— .058	—.0040	9	11
52	1687	1.7	18 25.625	3.21446	478	.006	—.00144	6 14 4.10	3.6099	4625	.038	—.0079		N
53	1662	6.4	22 8.816	18.55094	63412	8.022	+.01181	85 7 35.66	3.2903	26717	2.483	—.0069		N
54	1706	6.3	23 1.262	7.98044	7698	.436	—.00156	74 57 22.57	3.2342	11499	.349	+.0124		N
55	1751	5.5	29 55.061	5.99596	2712	.144	—.00177	65 37 34.15	2.5911	8678	.136	—.0337	14	17

* Maj.

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ'	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
56	1789	6.0	5 33 17.560	+ 2.98760	+.0000324	— .004	—.00026	— 3 38 10.93	+ 2.3379	—.004337	— .020	+.0062	15	14
57	1813	6.3	39 29.025	6.43751	2256	.195	—.00332	68 25 52.32	1.7300	9354	.107	—.0629	11	15
58	1821	6.0	39 34.191	3.44764	383	.010	—.00070	15 46 17.27	1.7864	5015	.021	+.0011	22	21
59	1846	5.3	42 31.641	3.36855	333	.009	— 00190	12 36 34.46	1.5116	4902	.016	—.0158	16	16
60	1862	6.0	45 16.259	3.40621	318	.009	—.00210	14 8 16.31	1.2898	4960	.014	+.0018	23	23
61	1874	7.0	5 47 50.816	+ 6.21420	+ 1221	— .171	—.00295	66 59 52.43	+ 1.0172	— 9050	— .053	—.0457	11	16
62	1923	6.0	54 17.298	4.32443	258	.033	+.00965	42 54 45.79	0.3511	6321	— .006	—.1487	23	23
63	1942	6.0	57 58.099	4.13501	182	.027	—.00032	38 29 28.93	+ 0.1357	6031	+ .002	—.0420	16	15
64	1970	6.5	6 2 0.277	3.61559	+ 141	.013	—.00245	22 12 28.27	— 0.1745	5268	.006	+.0008	20	19
65	2007	4.3	8 35.616	5.30028	— 399	.086	—.00012	59 3 10.51	0.7247	7721	.039	+.0271		N
66	2045	5.5	6 15 54.004	+ 5.24501	— 812	— .082	—.00218	58 28 56.15	— 1.3973	— 7622	+ .064	—.0072	18	18
67	2083	6.2	22 7.380	7.61230	4089	.378	— 03654	73 47 14.26	1.9664	10989	.214	—.0337	10	11
68	2101	7.5	22 48.877	3.62401	130	.013	—.00270	22 37 32.72	1.9910	5247	.034	+.0021	12	13
69	2126	4.4	26 8.672	3.24526	15	.007	—.00003	7 25 21.07	2.2870	4692	.028	—.0042		N
70	2139	6.7	27 57.173	4.12875	506	.025	—.00071	38 32 37.82	2.4613	5965	.057	—.0215	13	13
71	2159	5.1	6 30 24.188	+ 4.28990	— 698	— .031	—.00077	42 35 46.54	— 2.7119	— 6189	+ .069	—.0594	16	19
72	*2187	5.1	35 11.272	5.31695	2019	.084	—.00411	59 33 53.72	3.0706	7644	.135	—.0037	19	21
73	2233	6.0	44 3.520	3.59865	389	.012	—.00132	21 54 23.21	3.8614	5133	.060	—.0298	23	21
74	2301	6.5	55 33.689	3.81888	884	.015	+.01101	29 32 40.18	5 6255	5402	.091	—.8112	21	18
75	2317	6.3	7 1 33.458	11.67981	35652	1.495	+.00525	81 28 40.56	5.3582	16407	1.498	—.0362	15	19
76	2341	5.6	7 3 38.299	+ 4.69611	— 2349	— .044	—.00027	51 37 59.68	— 5.4925	— 6562	+ .171	+.0048	13	14
77	2358	4.1	5 28.829	3.06513	155	.004	—.00067	— 0 17 15.48	5.6309	4264	.057	+.0212		N
78	2365	7.7	7 48.006	5.20696	3758	.068	—.00529	59 8 14.81	5.8709	7231	.237	—.0243	13	14
79	2410	3.6	12 39.388	3.58903	726	.010	—.00189	22 12 37.58	6.2573	4944	.095	—.0056		N
80	2439	5.8	17 51.282	6.30888	8341	.142	+.00058	68 43 2.93	6.7301	8647	.438	—.0479		N
81	2473	4.8	7 22 50.261	+ 3.34290	— 523	— .006	—.00117	12 15 47.15	— 7.1017	— 4528	+ .088	—.0099		N
82	2488	5.8	27 26.887	4.37485	2480	.027	—.00280	46 27 12.20	7.4767	5886	.191	—.0091	11	11
83	2509	4.9	31 0.239	3.92828	1587	.015	—.00307	34 52 7.63	7.8851	5246	.149	—.1296		N
84	2551	3.7	36 53.968	3.63058	1096	.009	—.00233	24 41 44.71	8.2801	4790	.127	—.0515		N
85	2616	7.0	46 18.214	4.90192	4898	.039	+.00035	56 49 49.34	8.9950	6355	.305	—.0231	14	17
86	2585	6.6	7 46 43.781	+15.27834	— 123878	—1.757	—.00257	84 24 41.75	— 9.0370	— 19867	+4 573	—.0318	23	18
87	2660	5.4	53 20.442	2.99857	271	.001	—.00501	— 3 20 25.95	9.5220	3800	.087	+.0079	21	21
88	2676	6.3	56 27.588	3.54958	1169	.006	—.00455	22 25 9.48	9.7558	4475	.140	+.0018	16	16
89	2704	6.0	59 47.628	4.96971	5950	.034	— 00122	58 36 41.87	10.0901	6235	.352	—.0786	12	13
90	2786	5.2	8 12 28.130	3.65640	1661	.006	—.00176	27 37 14.44	11.3336	4417	.169	—.3769		N
91	2792	5.	8 14 19.908	+ 4.58132	— 4951	— .018	—.00274	53 37 12.17	—11.1928	— 5515	+ .314	—.0999	17	18
92	2819	3.5	19 51.800	5.04253	7647	.021	—.01719	61 8 1.23	11.6083	5957	.418	—.1155		N
93	2880	6.5	28 8.194	3.45879	1271	.002	—.00429	20 1 5.96	12.0785	3967	.158	.0000	21	21
94	2953	4.2	37 34.766	3.41847	1271	.001	—.00172	18 36 44.03	12.9579	3796	.160	—.2303		N
95	2982	5.5	43 3.436	5.00819	8968	.001	—.00328	62 25 39.75	13.0708	5472	.463	+.0237	27	24
96	3003	6.0	8 45 53.055	+ 5.22336	— 10816	+ .007	—.00501	65 4 47.54	—13.3693	— 5645	+ .524	—.0886	24	23
97	3052	6.0	50 36.236	3.35833	1157	.000	+.00301	16 3 35.26	13.5503	3547	.161	+.0371	26	23
98	3083	6.7	56 30.430	4.25797	5131	.001	—.01300	51 19 12.87	14.0420	4384	.319	—.0793	13	13
99	3109	6.0	9 0 29.562	3.61621	2148	.001	—.00407	30 9 19.01	14.2047	3656	.206	+.0062	17	17
100	3140	5.0	7 10.877	4.36340	6123	.008	+.00625	54 32 11.05	14.5532	4300	.354	+.0646	24	25
101	3170	6.5	9 11 56.642	+ 3.52033	— 1924	+ .002	—.00348	26 46 37.94	—14.9166	— 3369	+ .199	—.0167	9	11
102	3228	6.0	21 49.756	3.20010	838	.003	—.00289	8 43 56.79	15.4741	2902	.157	—.0093	13	14
103	3231	6.0	23 3.368	5.81249	21387	.152	+.01541	72 45 30.61	15.6072	5309	.799	—.0743	14	17
104	3281	6.0	30 33.134	3.76960	3445	.007	—.00295	40 47 59.00	15.9282	3265	.255	+.0113	19	21
105	3307	6.0	34 15.307	3.73939	3391	.008	—.00689	40 19 34.69	16.1742	3164	.252	—.0402	15	17
106	3375	7.0	9 46 9.550	+ 3.59771	— 2823	+ .009	—.00171	35 34 15.89	—16.7336	— 2820	+ .233	—.0030	15	14
107	3397	6.0	50 3.213	3.81469	4309	.015	—.00137	46 0 31.54	16.9601	2914	.278	—.0440	9	12
108	3468	6.0	10 3 48.030	3.57424	3096	.013	—.00551	38 1 0.17	17.5653	2452	.237	—.0340	11	12
109	3505	3.6	9 33.103	3.64573	3827	.017	—.01532	43 32 15.51	17.8074	2378	.254	—.0372		N
110	3495	5.6	11 9.018	9.80634	160804	6.885	—.09600	84 53 5.94	17.8886	6400	3.294	—.0540		N

* Mean A.B.

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ'	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
111	3530	6.0	10 14 44.321	+ 3.59054	—.0003573	+ .016	—.01279	41 51 47.04	—18.1164	—.002235	+ .246	—.1404	21	21
112	3551	6.1	17 7.409	3.03233	159	.007	—.00501	— 3 26 35.23	18.0605	1838	.151	+.0070	20	18
113	3584	6.0	22 48.377	3.52476	3229	.015	—.00202	39 33 50.76	18.2753	2035	.235	+.0024	16	19
114	3647	5.0	33 23.690	4.17155	11213	.108	—.02817	66 22 13.50	18.7145	2150	.388	—.0752	23	25
115	3693	5.8	39 47.972	3.18389	1035	.009	—.00992	14 51 14.67	18.8904	1506	.179	—.0516	39	36
116	3725	5.1	10 45 59.573	+ 3.67412	— 5908	+ .042	—.00967	55 14 56.39	—19.0313	— 1614	+ .274	—.0136	21	23
117	3751	7.0	49 47.288	3.26704	1770	.012	—.00332	26 10 1.59	19.1295	1353	.195	—.0090	15	15
118	3787	7.8	58 35.045	3.21245	1677	.012	—.03152	25 52 40.14	19.3981	1146	.186	—.0596	17	18
119	3825	6.7	11 5 27.361	3 52927	5624	.045	—.00283	55 34 23.41	19.4987	1129	.248	—.0097	11	14
120	3877	4.0	17 24.428	3.13061	654	.010	+.00937	11 13 3.04	19.7823	761	.175	—.0734		N
121	3914	4.1	11 23 57.710	+ 3.63952	— 11151	+ .154	—.00860	70 1 14.71	—19.8307	— 744	+ .274	—.0239		N
122	3949	6.0	31 6.713	3.27501	4171	.035	—.00710	51 18 38.87	19.9299	514	.202	—.0348	11	13
123	LL. 22186	7.5	37 35.183	3.14463	1757	.015	—.00382	30 16 25.28	19.9408	361	.179	+.0176	5	5
124	4010	6.4	45 46.132	3.47944	3134	.032	+.34093	38 36 55.24	25.7877	321	.240	—5.7721		N
125	W.B. 956	7.0	49 54.785	3.12117	— 2712	.023	—.00537	42 42 33.60	20.0439	— 114	.176	—.0091	7	8
126	4063	7.0	11 57 11.829	+ 3.06441	+ 422	+ .010	—.00647	— 4 46 59.70	—20.0549	+ 32	+ .166	—.0022	20	16
127	4070	5.7	58 25.584	3.15165	— 48131	3.874	—.06178	86 16 47.85	19.9778	55	.191	+.0760	29	26
128	4074	6.0	59 20.134	3.07126	5797	.069	—.00880	63 37 53.58	20.1359	73	.168	—.0818	19	19
129	4099	6.5	12 4 9.300	3.06241	722	.011	—.00219	17 30 17.81	20.0439	167	.165	+.0070	18	18
130	4123	3.4	9 13.914	3.00081	4260	.044	+.01382	57 43 38.27	20.0356	263	.156	+.0024		N
131	4141	6.	12 13 0.273	+ 3.03607	— 1015	+ .013	—.00284	23 43 45.16	—20.0327	+ 337	+ .161	—.0108	20	19
132	4195	4.6	20 42.369	2.99891	1257	.014	—.00657	28 57 48.51	20.0527	480	.155	—.0803		N
133	4217	6.0	24 7.806	2.85950	2969	.030	—.03144	52 13 32.78	19.9400	519	.135	+.0032	21	20
134	4239	3.9	28 8.244	2.59786	5412	.087	—.01261	70 28 39 03	19.8964	547	.101	+.0069		N
135	4271	5.1	35 33.461	3.03725	165	.010	+.00488	10 55 29.28	19.9102	771	.160	—.0969		N
136	4300	6.	12 41 58.304	+ 2.58448	— 3569	+ .046	—.00020	63 27 49.45	—19.7291	+ 771	+ .100	—.0102	13	14
137	4318	7.	45 59.257	2.98460	436	.011	—.00232	17 45 15.18	19.6361	952	.151	—.0043	15	14
138	4371	6.	56 53.585	2.36184	2704	.038	—.02840	64 16 55.50	19.4285	920	.077	+.0109	15	D
139	4403	6.7	13 3 39.125	2.95067	297	.010	—.00589	17 30 56.71	19.2846	1261	.145	+.0011	10	D
140	4433	5.5	8 2.768	2.72915	1348	.016	—.00529	40 48 54.77	19.1675	1245	.114	+.0093	19	15
141	4467	5.7	13 14 42.758	+ 2.69642	— 1244	+ .015	—.00615	40 48 26.06	—19.0115	+ 1338	+ 110	—.0135		N
142	4510	5.4	23 51.663	2.21159	1520	.021	—.01198	60 35 30.75	18.7026	1228	.066	+.0240		N
143	*4562	5.8	34 42.246	2.86584	— 215	.009	—.00473	20 35 19.01	18.3386	1755	.128	+.0277	28	23
144	4604	7.0	42 11.369	+ 3.09164	+ 800	+ .007	—.00292	— 2 12 59.63	18.0891	+ 2021	.158	+.0044	12	14
145	4643	6.3	45 59.908	— 2.04548	+ 54886	—2.010	+.02175	83 22 45.61	18.0066	— 1240	.668	—.0593	19	23
146	4694	7.2	14 0 53.630	+ 2.66069	— 374	+ .009	+.00002	31 26 53.82	—17.4277	+ 2028	+ .101	—.0994	17	14
147	4701	6.0	3 37.069	2.24714	626	.010	—.00533	50 2 58.10	17.1566	1753	.066	+.0504	21	21
148	4728	6.0	9 21.039	2.42131	496	.009	—.00461	42 6 22.85	17.0451	1958	.079	—.1011	14	12
149	4758	6.0	14 39.780	2.46386	416	.009	—.00028	39 22 9.29	16.6933	2063	.081	—.0024	17	17
150	4825	6.2	29 31.903	2.45312	224	.007	—.00354	37 10 33.39	15.9886	2238	.078	—.0536	17	17
151	4841	6.0	14 33 30.806	+ 2.25487	— 212	+ .007	—.01069	44 10 55.50	—15.6918	+ 2100	+ .064	+.0293	16	19
152	4874	6.2	38 56.377	1.48735	+ 1046	— .005	+.00866	61 47 42.71	15.4542	1461	.045	—.0323	16	19
153	4905	4.6	45 37.472	2.76605	217	+ .005	+.00903	19 37 14.04	15.1218	2741	.102	—.0803		N
154	4926	5.7	50 19.265	2.82767	354	+ .004	—.00299	14 57 9.49	14.7674	2851	.106	—.0009		N
155	4949	4.9	55 36.075	0.93382	2856	— .021	—.01339	66 25 50.42	14.4330	993	.058	+.0170		N
156	4974	4.9	14 59 40.343	+ 1.97993	+ 195	+ .003	—.03865	48 8 30.82	—14.1646	+ 2060	+ .049	+.0361		N
157	5000	7.2	15 5 35.112	2.42969	72	.004	—.00047	33 33 11.89	13.8331	2625	.070	—.0023	11	10
158	5072	5.3	16 48.324	2.40058	136	.004	—.00477	33 22 55.55	13 0931	2701	.065	+.0104	16	21
159	5113	6.7	25 24.620	1.90462	376	+ .001	—.00212	48 8 35.78	12.5294	2221	.044	—.0050	15	14
160	5147	5.9	25 10.716	0.82293	2658	— .018	—.01874	64 37 46.26	12.1847	981	.057	+.0806	15	20
161	5180	5.8	15 35 14.345	+ 2.75440	+ 412	+ .002	+.00032	16 25 44.63	—11.8507	+ 3293	+ .082	—.0093	21	20
162	5210	6.5	39 26.853	1.62603	721	— .002	—.00812	52 45 22.11	11.5070	1979	.038	+.0352	15	15
163	5236	6.0	43 25.472	2.46853	265	+ .003	—.00190	28 32 28.75	11.2549	3026	.062	+.0011	16	19
164	5271	4.6	48 21.287	2.07185	178	+ .001	+.03903	42 48 8.18	10.2675	2631	.042	+.6288		N
165	5295	5.5	51 14.803	+ 2.18162	271	+ .001	+.00323	38 18 32.54	10.5978	+ 2743	.046	+.0844	19	20

* Maj.

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ′	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
166	B.D.72.703	7.0	15 56 54.384	— 0.63714	+.0007861	— .054	—.01014	72 44 57.06	—10.2427	—.000767	+ .168	+.0179	6	7
167	5325	6.4	57 34.955	+ 2.96095	631	.001	—.00389	5 19 56.97	10.1956	+ 3756	.086	+.0169	19	16
168	5343	6.5	58 1.161	— 1.51902	13021	.090	+.00588	75 55 54.43	10.1955	— 1858	.297	—.0187	15	16
169	5366	6.0	16 2 26.482	+ 2.88865	553	.000	—.00184	8 52 4.99	9.8430	+ 3711	.079	—.0015	18	17
170	5405	6.0	7 4.377	+ 2.96279	614	.001	+.00069	5 20 31.84	9.4868	+ 3849	.081	—.0003	18	16
171	5462	5.5	16 14 24.859	— 1.80071	+ 12648	— .059	—.00052	76 11 29.11	— 8.9127	— 2293	+ .304	+.0030		N
172	5466	3.8	16 24.391	+ 2.64326	381	.000	—.00432	19 26 52.79	8.7129	+ 3500	.057	+.0463		N
173	5512	2.9	22 18.101	0.79905	1853	.010	—.00317	61 47 51.17	8.2369	1093	.044	+.0554		N
174	5568	6.0	32 32.500	1.74510	533	.002	—.00274	46 52 1.83	7.4603	2390	.029	+.0082	14	15
175	5619	5.8	39 15.046	2.21116	327	.000	—.00606	34 16 13.25	6.8496	3048	.033	+.0709	14	15
176	5658	6.0	16 44 17.644	+ 1.22618	+ 957	— .005	+.00315	55 37 55.19	— 6.5113	+ 1724	+ .028	—.0066	13	16
177	5703	6.3	49 55.234	2.45154	331	.001	—.00071	25 56 0.35	6.0480	3434	.035	— 0109	16	18
178	5752	5.5	57 4.066	+ 1.09339	959	— .005	—.00688	56 52 21.34	5.4073	+ 1549	.026	+.0306	20	16
179	5780	4.4	58 50.852	— 6.38651	30769	+ .560	+.00448	82 14 22.61	5.2927	— 8955	.924	—.0050		N
180	5774	5.9	17 1 46.818	+ 3.09194	521	— .004	—.00092	— 0 54 46.32	5.0679	+ 4385	.048	—.0281	22	21
181	5786	7.0	17 3 23.583	+ 2.47551	+ 325	— .001	—.00182	24 39 2.72	— 4.9452	+ 3519	+ .029	—.0421	13	16
182	5801	6.	5 23.866	1.14938	819	.004	—.00199	55 55 38.88	4.6969	1647	.022	+.0358	10	10
183	5828	3.2	9 53.866	2.46114	333	.001	—.00285	24 59 16.53	4.4989	3519	.026	—.1496		N
184	5842	4.8	12 42.531	2.21177	311	.001	—.00299	33 14 9.32	4.1053	3171	.020	+.0035		N
185	5911	5.7	23 25.523	1.58640	445	— .003	—.00092	48 21 56.97	3.2017	2297	.014	—.0149		N
186	5941	2.3	17 29 7.956	+ 2.78178	+ 333	— .002	+.00695	12 39 9.19	— 2.9184	+ 4042	+ .021	—.2256		N
187	6006	4.9	37 41.102	— 0.36028	1077	+ .004	+.00077	68 48 55.94	1.6344	— 513	.027	+.3151		N
188	6122	5.8	57 21.255	— 1.04540	571	+ .021	+.00081	72 0 59.20	— 0.2393	— 1522	+ .016	—.0078	19	21
189	6143	3.7	18 1 25.433	+ 2.84192	181	— .003	—.00546	9 32 51.52	+ 0.2215	+ 4136	— .002	+.0969		N
190	6193	6.	8 54.682	1.99699	213	— .001	—.00345	38 44 22.70	0.7839	2902	.002	+.0043	15	13
191	6203	5.3	18 11 45.540	+ 1.86336	+ 204	— .002	—.00170	42 7 3.70	+ 1.0309	+ 2707	— .002	+.0024		N
192	6232	6.5	15 2.707	2.31200	192	.001	—.00198	29 36 47.62	1.3258	3356	.006	+.0102	12	14
193	6246	6.3	17 0.418	1.40442	159	.003	—.00402	51 17 36.32	1.4358	2030	.002	— 0510	14	D
194	6258	6.0	18 33.020	1.40906	136	.003	—.00336	51 14 28.25	1.6091	2036	.002	—.0122	10	15
195	6300	5.7	24 24.823	2.48523	+ 162	.001	—.00113	23 47 3.76	2.1449	3593	.013	+.0137	19	19
196	6348	5.5	18 30 25.204	+ 1.03378	— 86	— .004	—.00171	56 57 1.74	+ 2.6403	+ 1481	— .007	—.0137	19	10
197	6373	6.5	36 53.277	0.72915	— 385	.004	—.00151	60 35 43.03	3.2589	1034	.012	+.0451	10	8
198	6387	4.3	40 16.953	2.57899	+ 168	.001	—.00297	20 25 41.21	3.1726	3684	.022	—.3341		N
199	6476	6.0	51 29.318	1.58105	+ 29	.002	—.00742	48 42 18.81	4.3436	2218	.012	—.1240	13	14
200	6491	3.3	54 16.088	2.24219	+ 134	.001	—.00148	32 31 9.37	4.7073	3156	.023	+.0029		N
201	6534	5.7	19 0 12.139	+ 2.28341	+ 142	— .000	+.00417	31 33 32.09	+ 5.1369	+ 3199	— .025	—.0706	9	11
202	6579 Pr.	6.0	8 50.808	1.55271	— 286	.002	—.01785	49 37 16.35	6.5555	2113	.022	+.6214	20	21
203	6599	4.5	12 1.813	2.07950	+ 102	.000	—.00251	37 54 43.78	6.2136	2854	.026	+.0140		N
204	6656	6.5	19 59.521	1.89539	+ 55	.001	+.00067	43 8 42.92	6.8221	2569	.024	—.0362	11	13
205	6697	3.9	26 33.255	1.51300	— 248	— .002	+.00108	51 27 51.02	7.5200	2021	.024	+.1250		N
206	6740	4.0	19 34 26.409	+ 2.36776	+ 108	+ .001	—.00102	29 51 58.67	+ 8.0787	+ 3128	— .042	+.0468	19	20
207	6784	5.0	41 40.937	2 27490	+ 201	+ .001	.00000	33 26 16.24	8.1687	2959	.039	—.4397	25	27
208	6830	6.0	48 26.257	1.76583	— 57	— .001	—.00267	47 36 35.63	9.1315	2249	.030	—.0070	17	20
209	6876	5.7	55 24.928	1.88461	+ 28	+ .000	+.00112	45 25 54.75	9.6580	2367	.033	—.0197	12	15
210	6915	5.6	20 1 43.209	2.22602	+ 218	+ .002	—.02003	35 37 44.60	9.7303	2730	.044	—.4269	16	20
211	6962	4.2	20 9 22.335	+ 1.88520	+ 39	+ .001	+.00067	46 26 17.74	+10.7147	+ 2377	— .036	—.0141		N
212	6998	5.3	13 51.062	2.30267	+ 191	+ .002	—.00035	34 35 35.01	11.0686	2754	.052	+.0108	14	18
213	7037	6.0	19 32.269	0.29206	— 3835	— .029	+.00119	68 28 49.72	11.5024	301	.077	+.0330	17	19
214	7094	5.6	28 2.298	2.83728	— 88	+ .002	+.00368	12 36 0.59	12.1104	3257	.092	+.0388	20	18
215	7140	4.8	32 56.283	2.67653	+ 94	+ .003	+.00244	20 45 48.92	12.4224	3016	.081	+.0112		N
216	7138	5.0	20 33 0.477	+ 3.07585	— 440	+ .001	+.00449	0 2 53.76	+12.4130	+ 3474	— .117	—.0029	20	19
217	7178	6.0	35 59.559	— 3.46948	— 38815	— .551	+.01342	80 59 35.47	12.6219	— 3971	.862	+.0019	25	25
218	7176	6.0	37 38.525	+ 1.27913	— 988	— .007	—.00011	60 3 13.32	12.8991	+ 1386	.039	+.1673	16	14
219	7213	4.5	42 32.435	2.33413	+ 314	+ .004	—.00011	36 1 55.75	13.0627	2527	.061	+.0026		N
220	7254	5.6	48 56.674	2.09498	+ 309	+ .004	+.00258	44 42 32.10	13.4748	2207	.053	—.0053	13	15

	B. A. C.	Mg.	α 1875.0	$\frac{d\alpha}{dt}$	$\frac{d^2\alpha}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$	μ	δ 1875.0	$\frac{d\delta}{dt}$	$\frac{d^2\delta}{dt^2}$	$\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$	μ'	$\frac{A}{\alpha}$	$\frac{A}{\delta}$
			h m s					° ′ ″						
221	7297	6.8	20 55 8.805	+ 2.28855	+ 385	+ .005	+.01945	39 45 52.58	+14.0843	+ 2370	— .060	+.2072	12	15
222	7326	7.0	59 11.374	2.24274	+ 429	+ .005	—.00089	41 8 4.30	14.0826	2259	.059	—.0476	16	17
223	7380	4.1	21 9 34.505	+ 2.99964	— 275	+ .004	+.00231	4 43 55.51	14.6840	+ 2900	.126	—.0764		N
224	7438	6.0	17 2.098	— 0.54914	— 13095	— .195	+.00906	76 29 8.40	15.2049	— 579	.210	+.0105	15	18
225	7509	7.3	28 59.097	— 0.17576	— 10728	— .162	—.00016	75 51 14.56	15.8451	— 225	.160	—.0107	14	14
226	7522	5.8	21 32 16.307	+ 3.00552	— 226	+ .005	+.00651	5 12 30.91	+16.0611	+ 2570	— .135	+.0308	19	19
227	7561	2.5	38 2.800	2.94569	— 54	+ .006	+.00058	9 18 9.89	16.3381	2424	.129	+.0093		N
228	7597	5.0	41 32.269	0.75768	— 4063	— .052	—.01174	71 44 50.27	16.4609	547	.065	—.0433	21	22
229	7610	6.7	44 48.584	1.07425	— 2310	— .026	—.00131	69 34 17.31	16.6339	799	.050	—.0313	19	19
230	7641	5.6	50 50.663	2.92387	+ 73	+ .006	—.00329	11 29 0.62	16.9434	2202	.130	—.0098	23	18
231	B.D.59.2444	7.4	21 55 23.038	+ 1.87498	+ 629	+ .009	—.01368	59 41 56.30	+17.1664	+ 1330	— .048	+.0044	2	3
232	7685	6.0	58 21.651	3.08735	— 444	+ .006	—.00274	— 1 30 36.43	17.2535	2203	.154	—.0418	22	19
233	7712	6.0	22 1 58.058	+ 2.81316	+ 482	+ .008	—.00505	21 5 42.22	17.3875	+ 1942	.119	—.0655	17	18
234	7732 Pr.	7.5	2 36.064	— 1.82387	— 41949	—1.214	—.07011	82 16 2.88	17.4382	— 1430	.551	—.0419	14	20
235	*7760	6.2	7 47.510	+ 1.37936	— 1001	— .010	—.00990	69 30 55.01	17.7058	+ 863	.042	+.0075	19	22
236	7796	5.1	22 15 21.940	+ 2.95157	+ 186	+ .008	+.00006	11 34 33.48	+18.0168	+ 1820	— .139	+.0166		N
237	7820	5.0	19 27.071	2.42089	1502	.015	—.00164	48 50 35.16	18.1416	1421	.080	—.0133	21	24
238	7843	5.5	24 18.856	2.73673	1053	.011	+.00236	31 55 59.80	18.3258	1541	.113	—.0058		N
239	7915	6.0	35 53.019	2.67372	1478	.014	—.00202	39 34 22.44	18.7157	1318	.107	—.0029	12	14
240	7932	5.1	38 31.178	2.66317	1578	.015	—.00220	41 9 49.01	18.8149	1270	.106	+.0148		N
241	7962	6.	22 44 43.689	+ 2.69296	+ 1680	+ .015	—.00053	41 17 30.61	+18.9762	+ 1185	— .110	—.0061	15	18
242	7978	6.7	47 28.894	2.72890	1638	.015	—.00037	39 30 12.46	19.0465	1156	.114	—.0121	9	12
243	8024	6.5	56 13.899	2.51745	2636	.027	—.00138	56 26 3.21	19.2766	925	.092	—.0064	14	12
244	8052	4.5	23 1 1.528	2.91336	1074	.011	—.00171	24 47 38.07	19.3660	997	.140	—.0279	20	21
245	8078	5.2	5 25.566	3.02596	291	.009	—.00173	8 2 29 52	19.5022	957	.157	+.0139		N
246	8122	6.8	23 13 22.079	+ 2.17376	+ 3954	+ .068	—.01451	73 0 21.60	+19.6084	+ 552	— .063	—.0321	15	15
247	8195	6.	25 8.838	2.93427	2146	.018	+.02341	38 32 58.87	19.7497	568	.144	—.0731	25	27
248	8229	4.3	32 0.619	2.92399	2500	.020	+.00139	42 34 34.12	19.9075	434	.144	+.0026		N
249	8252	6.5	37 0.710	2.89691	3494	.031	—.00112	52 27 33.04	19.9492	337	.139	—.0042	10	10
250	8284	6.0	43 19.993	3.02431	1642	.014	+.00403	28 8 47.79	20.0206	235	.159	+.0194	21	19
251	8317	7.5	23 49 18.287	+ 2.97533	+ 4392	+ .041	—.00191	56 42 59.50	+20.0216	+ 116	— .151	—.0108	13	14
252	8324	4.8	51 24.502	3.04540	1476	.013	—.00407	24 26 47.38	20.0143	+ 80	.163	—.0258		N
253	8356	7.0	56 21.235	2.90393	19789	.714	—.01147	82 16 38.46	20.0355	— 19	.141	—.0162	15	15
254	8365	6.5	23 58 39.339	3.07383	120	.010	+.00142	— 1 11 50.15	20.0000	— 60	.167	—.0539	23	24

* Maj.